

THE REPAIR OF SURFACE DEFECTS OF THE HAND*

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AN ATTEMPT will be made here to illustrate the representative problems that have occurred in a rather large group of surface deformities of the hand. A definite finding has been that free skin grafts have given satisfactory results in a high percentage of patients and in many where the use of a pedicled flap might have been thought necessary. The application of free grafts may require more time at one operation, but the total amount of work may be much less. If the free graft does not give a satisfactory result, then it can be replaced with a flap, but this has not been found necessary in this series.

Where deeper work is going to be necessary—such as nerve, tendon, bone or joint repair, or if these structures are too much exposed—then a pedicle flap containing some subcutaneous fat may be desirable.

A simple, fundamental rule can be deduced: That when the full-thickness of the skin has been lost, even over small areas, in such a kinetic region as the hand, the indication for treatment is to restore this loss as completely and as soon as possible.

One note of warning should be made of the frequent recommendations for certain methods of treatment that “do not leave scars.” This is a fallacy if there has been a full-thickness loss, and carrying out the plan of waiting for some application to produce healing has resulted in permanently crippled hands. Frequently, along with this plan, the thumb has been dressed right alongside the index finger with disregard of the position of function.

The repair of tendons and nerves is considered a separate phase in reconstructive surgery of the hand, and one naturally follows the advice of the most consistent workers in this field—extensive reports of which have been made by Kanavel, Koch and Mason.

Fresh Superficial Burns.—A fresh burn of the hand can probably best be managed by open surgical drainage, using wet packs or grease gauze, rather

* In the 1919 edition of Da Costa's Surgery, there is an illustration of a full-thickness skin graft which was accomplished by Dr. George Summers Brown, a former surgeon of Birmingham, Ala., and by Dr. J. M. Mason, for the correction of a burn deformity of the hand. The result of this operation, performed some time before 1910, is excellent, and better than many obtained to-day in single operations for such lesions. As Doctor Brown was a member of the Southern Surgical Association, perhaps nothing could have made him happier than to be present at this Anniversary Meeting, and it is in his memory that I would like to present the following communication.

than sealing the area as with tannic acid or plaster of paris. The open method allows early determination of the depth of the loss and movement of the joints, and, if there has been no full-thickness loss of skin, early healing and return to function can usually be obtained by simple débridement of the dead surface and keeping the hand clean and comfortable. If infection does develop in this type of wound, or if the hand is neglected and left out of the

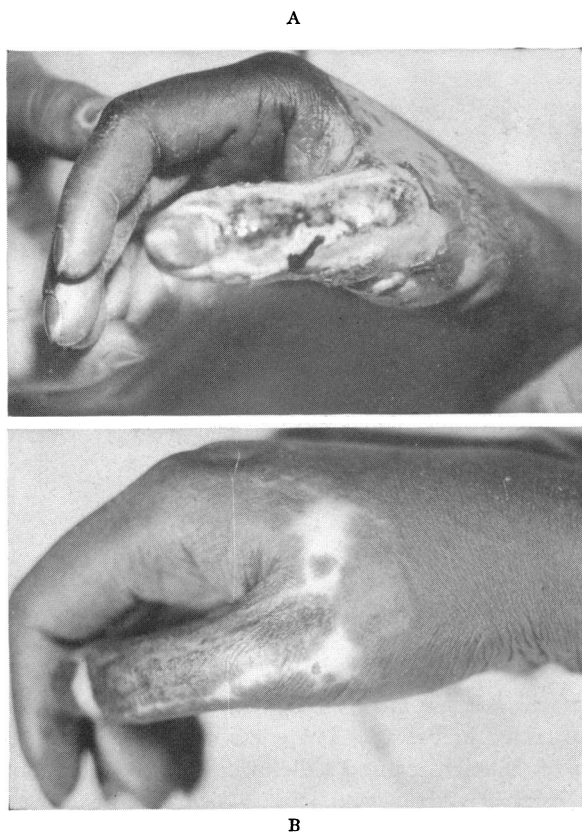


FIG. 1.—(A) Laundry burn with full-thickness loss of skin of entire dorsum of thumb, grafted after two weeks. (B) Complete permanent coverage with thick split-graft, after seven months.

position of function, a marked crippling may result from deep fixation of tendons and joints, and possibly from loss of the skin itself from infection.

Fresh Deep Burns.—A full-thickness loss over the back of the thumb that was sustained in a laundry-press is shown in Fig. 1. The wound was gently débrided, and open drainage with wet dressings started. At the end of two weeks the area was covered with a thick, split-skin graft and complete function without deformity has resulted. (Patient cared for by Dr. Gene Bricker, Resident Surgeon at Barnes Hospital.) Another laundry-press loss is shown in Fig. 2, when seen one month after the accident. Gentle débridement (which includes soap and water cleansing and the removal of dead skin), and salt

packs were used; in five days the granulations were carefully cut away, and the entire defect covered with a split-skin graft from the thigh. This patient has been recorded before but is again reported here, after four years, to show that there has been complete and permanent function.

Late Unhealed Burns.—If losses have been very widespread, there may be repeated ulceration and permanent healing may never occur. The plan of restoration in patients with open wounds is to graft these areas first so the region will be clean when the hand is opened for correcting the deformity.

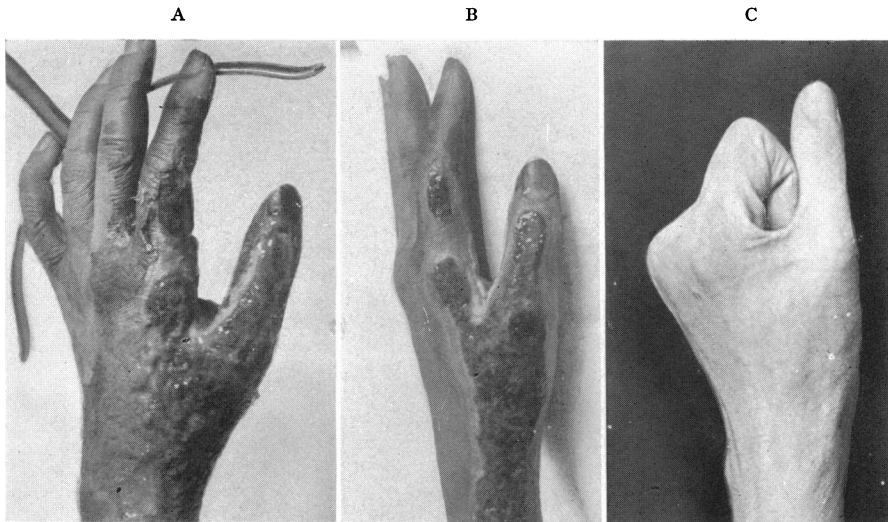


FIG. 2.—(A) One month after laundry mangle injury and burn. (B) Two days later, after gentle débridement and saline dressings. Operation performed three days later, at which the granulations were carefully cut away down to a firm base, and the entire area was covered with a single large, thick split-graft. (C) Complete and permanent function shown after four years.

This type of unhealed lesion after 14 months with complete loss of use of the left hand is illustrated in Fig. 3. The contracture has drawn the thumb out of the position of function, caused a deformity of the joint surface and dislocation of the metacarpophalangeal joint. After the arms were healed with split-skin grafts, then the contracture was carefully opened so the thumb could be put in fairly good position, and the resulting defects were filled with split-grafts. A second releasing operation was necessary, and a direct circumferential wire was put around the metacarpal to hold it out in position while the grafts were becoming fixed. The result is shown in Fig. 3 B with the thumb and fingers functioning for the first time since the accident.

Late Deformities Repaired with Free, Thick Split-Grafts.—Many late deformities can be repaired by carefully dissecting the scar so that complete correction can be obtained with little or no tendon exposure, and then covering the defects with thick split-grafts. The patient shown in Fig. 4 is chosen to represent this because of the extensiveness and occurrence of contractures in both hands.

The split-graft is cut one-half to three-fourths the thickness of the skin

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deep—if possible, in a single piece large enough to cover the entire area. It is sewed on at about normal skin tension with running horsehair sutures all around, usually with the graft overlapping the wound edge, and basted through

A

B

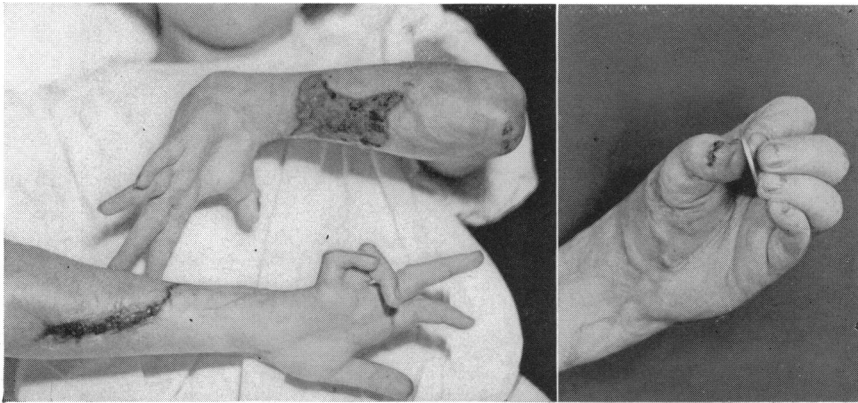
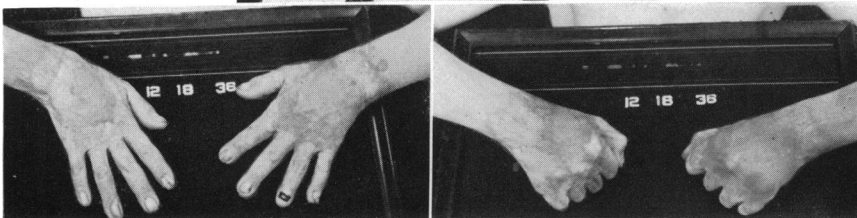
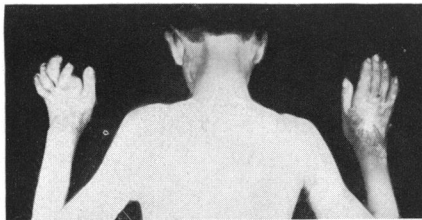


FIG. 3.—(A) Left hand completely out of position of function 18 months after a deep burn; with the arm still not healed. (B) Fairly normal position restored by three split-graft operations; with thumb and fingers functioning for the first time since the burn.

the center after multiple stab holes are made in the graft for drainage. (The general details of splinting and dressing are described later under full-thickness grafts.)

A



B

C

FIG. 4.—(A) Widespread deep burns of the dorsum of both hands; corrected by careful dissection of the scar without damage to the tendons and covering each area with one large split-graft. (B) and (C) Shows complete permanent function three years later.

If ulcerated areas such as roentgen ray burns and the arm in Fig. 3 are grafted, the first dressing is the same except that the gauze next to the graft is wet with saline and is kept wet with irrigating tubes incorporated in the dressing, for four days. This plan of wet dressing is open to question, but,

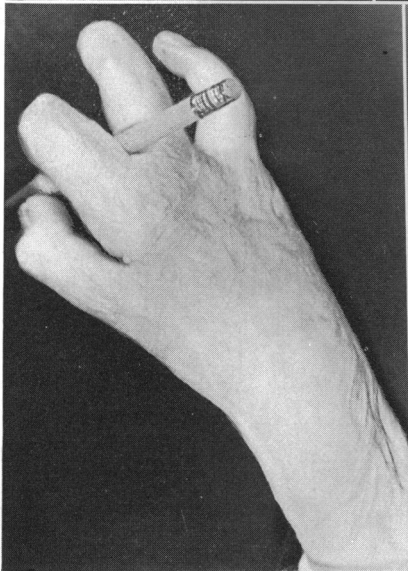
A



B



C



D



E

FIG. 5.—See legend on opposite page.

for the present, it seems to be the safest for the success of the graft, in most contaminated areas.

The split-graft is rough at first; the fine silk ligatures may work through to the surface, and have to be removed (Fig. 10 *D*); and many sebaceous collections may have to be emptied by pressure or small incisions. However, the grafts usually clear up so that in six to eight months they cannot be distinguished from a full-thickness graft or even normal skin in some instances (Fig. 2).

Partial Restoration of Function.—In some patients the deformities are so bad that complete function can never be expected. These result from excessive widespread surface loss, deep losses of tendons and dislocation of joints from primary or secondary contractures. Many of these deformities might be prevented by adopting the view that the lost skin should be replaced early; and there probably can never be any excuse for the completely webbed, or degloved hand as it has been called.

One of these patients is shown in Fig. 5 *A* and *B* who could not even dress himself. The thumb, fingers, and wrist were all out of position of function and the situation seemed almost hopeless, but in four operations the scars have gradually been removed, and the surface covered with thick split-grafts, so that the thumb is fairly well around and the wrist is up (Fig. 5, *C* and *D*). This result is not complete function, but the patient is able to get around normally and some of his work in occupational therapy is illustrated in Fig. 5 *E*. He is also able to draw and hopes to enter art school. His left hand was even worse than the right and was repaired in the same way.

Healed Deformities Repaired with Free Full-Thickness Grafts.—*Dorsal surface loss* can in many instances be successfully replaced with thick split-grafts (Fig. 4). Although there seems to be no actual measure of advantage of final function of the full-thickness graft, it is often relied upon, however, where widespread clean dissection and removal of the binding scar can be accomplished.

The patient in Fig. 6 *A* has complete loss of the use of the hand, with thumb and wrist entirely out of the position of function, and the fingers so held back that metacarpophalangeal dislocations and joint deformities will occur. This is the result of a widespread surface loss, but the depth of scar cannot be determined until the dissection of it has progressed. In this instance, complete function and movement were restored with a single free full-thickness graft from the abdomen put on at one operation, and covering the entire area (Fig. 6 *B*). At operation the scar is very carefully dissected from the underlying tendons; rough, forceful flexion of the wrist (or any other joint area

FIG. 5.—(A) and (B) Complete loss of use of hand one year after severe burns which have destroyed all the skin and many of the tendons and joints. Patient unable to dress himself. (C) and (D) After several operations of a rather slow progress in removing the scar skin and replacing it with split-grafts. Appearance not good, but patient able to draw well enough to enter art school and do work as shown in (E). (E) Part of many objects made as a result of instruction by occupational therapists.

that is being opened) will tear the scar overlying tendons and cause undesirable exposure of the tendons themselves. The scar is removed in layers if necessary, and, with cross-cuts in small areas to allow stretching, and the contracted tendons have to be gradually pulled out so that complete flexion can be obtained if possible. It is even advisable to leave a thin layer of scar on the tendons rather than expose them, if a free graft is to be used, because the graft will not grow on a large area of exposed tendons. When all relaxation

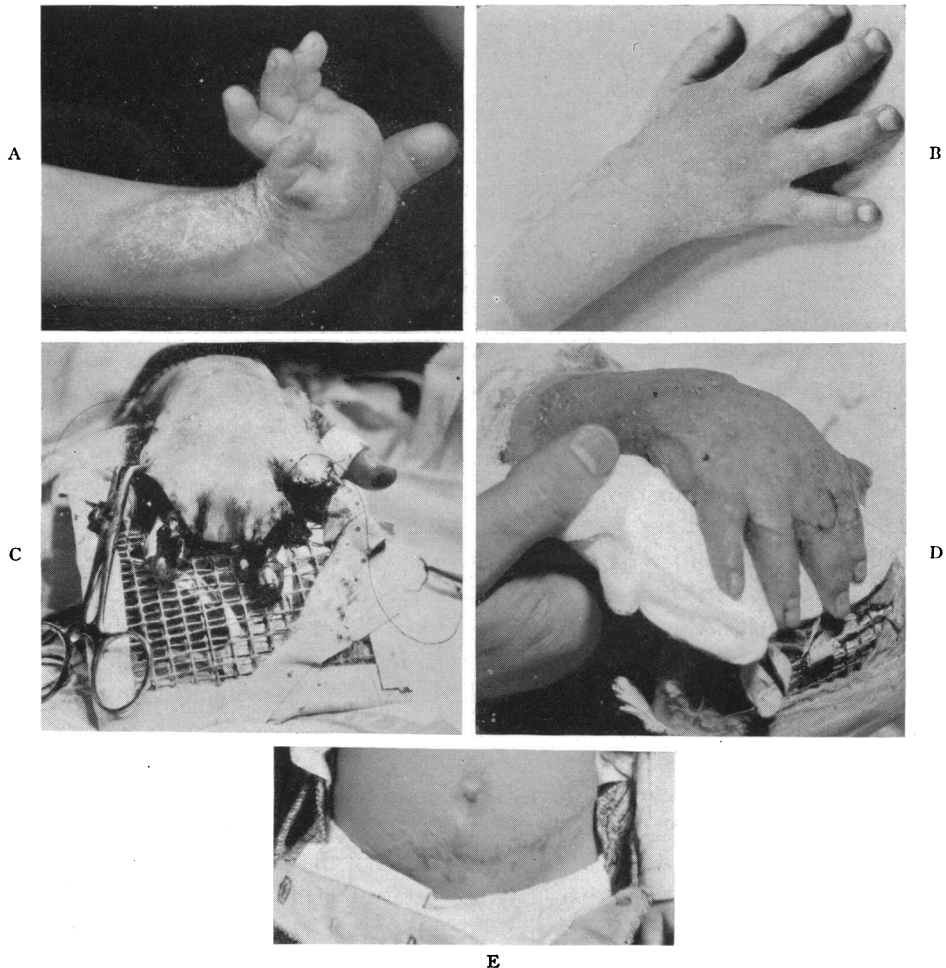


FIG. 6.—(A) Complete extension deformity following a widespread full-thickness loss of skin, with thumb and fingers definitely out of position of function. (B) Full restoration of function after careful dissection and coverage with a single full-thickness graft. Shown after two years to indicate the permanence of the result. There is complete flexion of the wrist and all carpal joints. (C) Method of fastening hand to wire (or solid aluminum splint) with sterile adhesive and of application of the graft (three hours operative time). (D) Three weeks after operation; full-take of graft; arm being taken off splint. (E) Abdominal defect healed by direct suture.

possible has been obtained, the hand is fastened to the wire mesh splint as illustrated, or to an aluminum splint prepared ahead of time, using sterile adhesive. The splint is bent to throw the wrist and fingers as far out of the former contracted position as possible and an accurate pattern of the defect is

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cut. A full-thickness graft is then sutured all around the edges and up on the fingers (Fig. 6 C). The hand is shown in Fig. 6 D after three weeks' time with a full-take of the graft; it is now ready to be removed from the splint, and function can be started.

If the defect will not open completely at the first attempt because of tendons that are too tight or for fear of exposing too much of them on forced manipu-

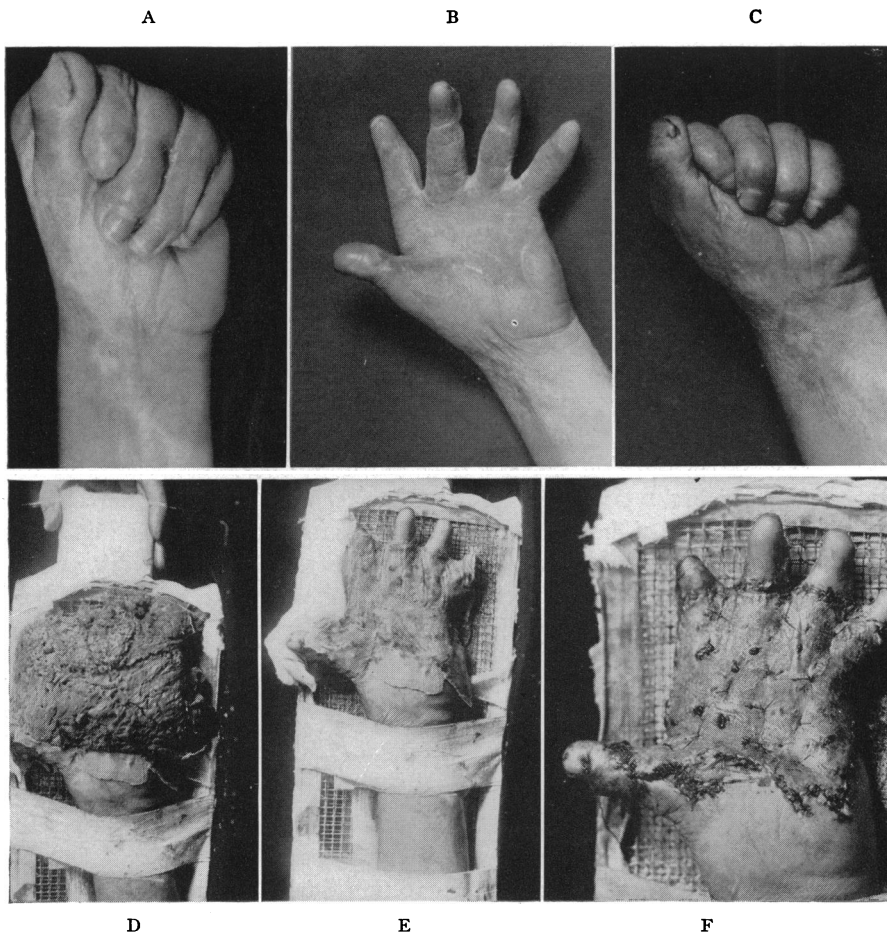


FIG. 7.—(A) Complete flexion deformity and webbing of the fingers several years after a burn. (B) and (C) Full function obtained with one full-thickness graft and two subsequent procedures to relieve the webbing. (D) Hand shown at time of first dressing with molded marine sponge in place. Dorsal surface well padded. (E) Fine mesh, grease gauze next to the graft which is dry, indicating full-take of the graft. (F) Full-take shown with edge sutures; individual mattress sutures through the surface; stab-holes through the graft; and fingers held extended with silver wires through each tip and held to the wire splint.

lation, then whatever areas are open are grafted, and further freeing and grafting is done subsequently (Figs. 3 and 5). If tendons are lost and have to be replaced, or if they are too much exposed, then the advisability of using a thicker pedicle flap must be considered (Figs. 13 and 14).

Tunnel grafts have been reported as giving satisfactory results, especially

along the dorsal surfaces of the fingers, but they have not been employed in this group of patients.

Palmar surface losses can nearly always be repaired with free grafts. Deep losses along the fingers may require thicker flap repair, but full function in one of these is seldom obtained. The contracted single finger, especially in a child, that shows keloid formation, with its probable deep inflammation, may be one of the hardest deformities to repair, and careful consideration should always be given this apparently simple lesion.

The hand in Fig. 7 *A* has a complete flexion deformity and webbing of the fingers. Restoration was obtained with one full-thickness graft and two subsequent operations for the release of the webs (Fig. 7 *B* and *C*). The first dressing is shown in Fig. 7 *D*, *E* and *F*. The fingers have been held with silver transfixion wires around the terminal phalanges and fastened to the wire splint. The wire is used instead of tape when the graft comes so far out on the fingers. A pad of gauze separates the dorsal surface from the wire splint, and, over the knuckles, a thin rubber sponge may be used.

The question of late function of a free graft in the palm might well arise, and, in the answer, the anatomy may be considered. The skin and subcutaneous tissues of the palm are different than elsewhere; for normal function, the thenar pad is essential, the thumb must be as strong as the fingers and normal position and movements of the fingers are essential. When this area is resurfaced, the skin necessarily must come from another part of the body and it always retains its original characteristics and does not change into the type of skin of the sound palm. The grafts shown here in Figs. 7 to 10 have stood up under the patient's requirements, but, if any work proves to be too strenuous, there is little that can be done other than have the patient wear a glove for protection. In this instance, substituting a pedicle flap would seldom be of benefit because the difference of the skin surface would be the same as the free graft.

Details of the Full-Thickness Graft.—The 14 year old contracture, shown in Fig. 8 *A*, gave promise of a fairly good correction because there had been preservation of joint movement and tendon activity. The lengthening of these tendons by traction is not certain until the area is opened, but, for a successful correction in one operation, it is necessary that the entire deformity be opened and the hand maintained in complete correction during the period of healing of the graft. This point is almost as important when a pedicle flap is being employed and will be referred to later in Fig. 13.

Preparation of Bed for Graft.—Fig. 8 *B* shows the freeing obtained by removal of the small, transverse, heavy scars and then careful dissection backward of the palmar flaps without damage of the nerves or complete exposure of the tendons. The edges of the defect are not straight lines but have "darts" in them to allow maximum replacement of skin. If a straight, narrow graft is put in a child's finger, a possible keloid along the edge may produce deformity. The palmar flaps are utilized in making new interdigital spaces and for part of the finger coverage, and then patterns of the defects are cut in thin sheet

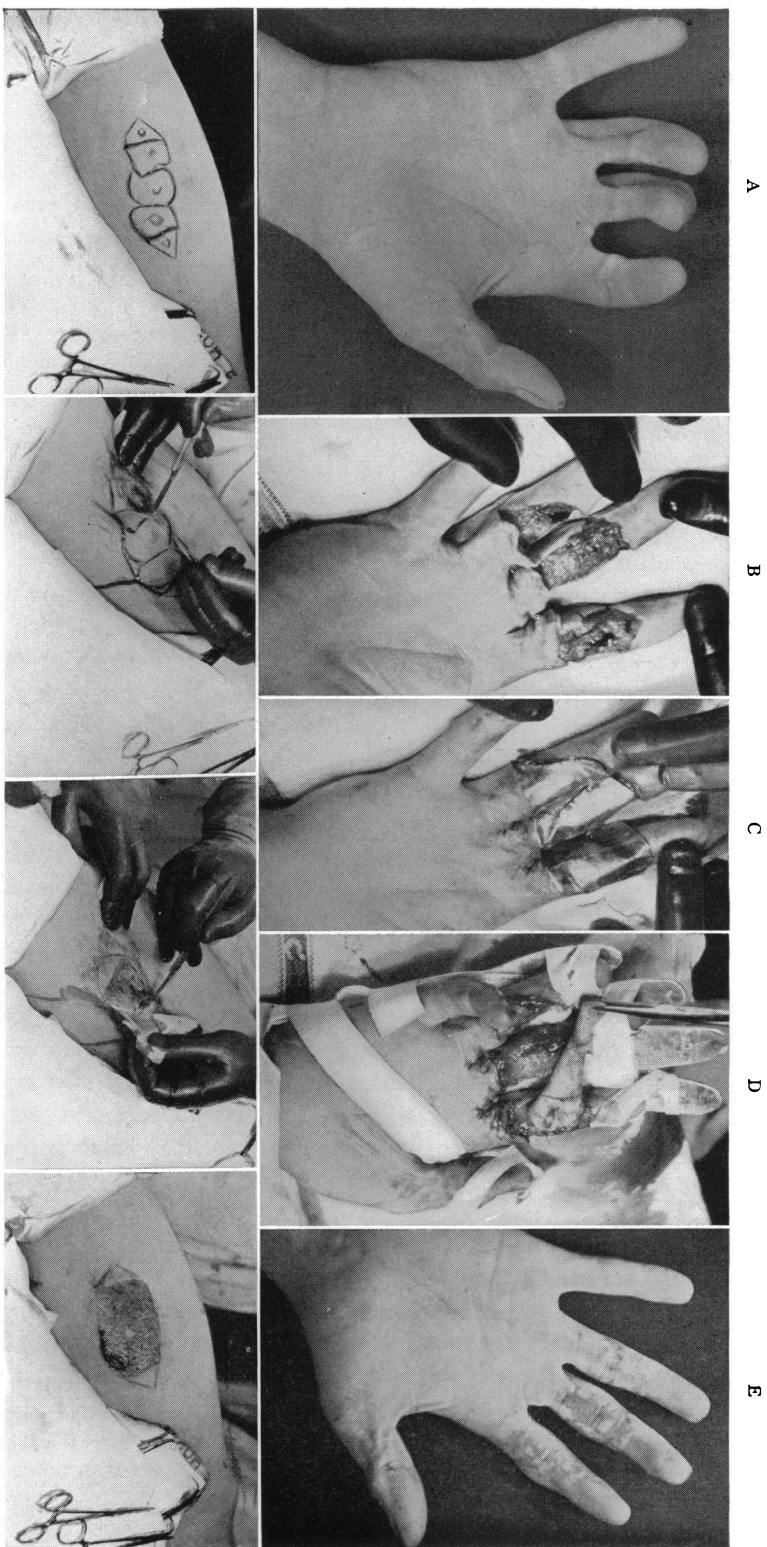


FIG. 8—(A) Flexion deformity of 14 years' standing. (B) Careful opening without damage to nerves or tendons; careful hemostasis; fingers can be straightened. (C) The interdigital spaces have been made out of the contracted palmar skin. Lead patterns have been cut of all three defects. (D) The graft is sewed accurately all around the edges of the separate defects and mattress sutures are put through the surface if necessary. (E) Result three months later. Patient satisfied with function, which is apparently normal. (F) The patterns have been traced and outlined through the skin of the inner part of the thigh. (G) and (H) The full-thickness of the skin is raised with as little damage as possible, using fine forceps and gauze for holding. No fat is taken up on the graft. (I) The graft is free and the resultant wound can be sutured or covered with a split-graft from an adjacent area.

lead (Fig. 8 C). Careful hemostasis is done with pressure and ligatures of white No. triple o silk.*

Cutting the Graft.—The patterns are outlined on the inner side of the thigh and an incision is made just through the skin (Fig. 8 F). Elevation of the full-thickness of the skin is then accomplished, using small forceps or gauze traction on the graft and some countertraction on the edges of the donor area to prevent any subcutaneous fat from adhering to the graft. Some small particles may persist which may be removed with scissors later—if these would retain their viability, they would be of great advantage (Fig. 8 G and H). The resultant defect of the donor area can now be closed directly or, if too large, can be covered rapidly with a split-skin graft from an adjacent area (Fig. 8 I).

Application of Graft.—The hand is fastened to a wire or aluminum splint with sterile adhesive, with the fingers extended, and can then be handled much more easily. The graft is sewed accurately into place all around the edges, in order to favor obtaining primary union; where edges are too loose to allow a normal stretch of the graft, reefing sutures may be taken to pull the edges back away from the defect. The tension with which the graft is sewed on—that is, from side-to-side—is best described as normal skin tension, *i.e.*, not pulled tightly like a drum-head, or left so loose that it may wrinkle (Fig. 8 D). If the graft is larger, then it is held down to the bed with additional mattress sutures through the surface (Fig. 7 F).

Dressing the Graft.—A few drainage holes are put through the graft and one layer of fine mesh, greased gauze (5 per cent scarlet red, xeroform or zinc oxide) is placed, very smoothly, next to the graft. Over this one or two gauze flats are placed and cotton or soft marine sponge is packed carefully between the fingers. Over this a soft, bleached, “wool-form” sea sponge is placed and bandaged firmly in place. A board splint is added for stability and the ends of the fingers are left visible. Fig. 7 D, E and F show a hand at the time of the first dressing, done eight days after operation. There is a full-take of the graft with no sign of infection, but dressings must be maintained for two weeks longer, using wet applications if inflammation should occur—otherwise continuing with the greased gauze. The sutures can be removed at the first or later dressings, and there may be an apparent delay in healing because so much of the surrounding, heavily keratinized skin comes away.

The splint is usually maintained for three weeks and then movements are gradually restored. This long fixation, which is primarily for the graft, helps the tendon lengthening also, but it does not do joint movement any good. If there is tendency for contraction after this period, the patient is usually allowed to go about his activities during the day, and at night the dorsal splint

* All possible skin is saved and utilized in making these repairs, and flaps may be shifted some distance, but the so-called Z-plastic, in which scar webs and bands are entirely depended on to obtain relaxation, and function has not been relied on in any patient in this series.

is reapplied, using either an aluminum one or a simple one made of wood and held on with adhesive.

Persistence of Function and Growth of a Free Skin Graft over a Nine-Year Period.—An important indication to the use of free grafts in general, in children, is illustrated by the patient shown in Fig. 9 *A*, who had a complete flexion deformity of the hand, of one year's duration. This was entirely corrected in one operation, with a single full-thickness graft covering the

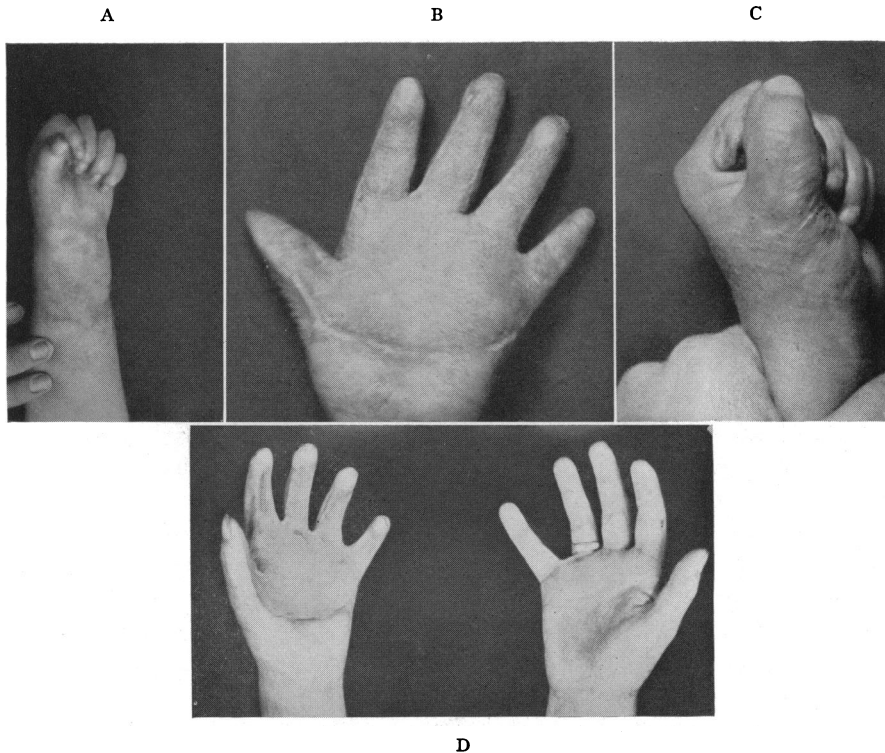


FIG. 9.—(A) Complete flexion deformity of one year's duration. (B) and (C) Full function obtained by careful opening of the hand and covering with a full-thickness graft. Shown here one year later after removal of a slight webbing. (D) Shows same hand after nine years, with about same relative size, as compared with the other hand, having been preserved. Patient completely satisfied, and not desirous of any further operative procedure.

palm and palmar surfaces of the fingers and thumb—three and one-half hours' operative time—(Fig. 9 *B* and *C*). The same hand is shown nine years later in Fig. 9 *D*, with full function being retained, and the boy satisfied and able to play baseball. The comparison in size with the right hand is about the same as when originally seen, the hand having about kept pace with the normal one, but not having picked up what was lost during the year of deformity. If there should be a lag in growth, dependent upon the graft, more skin could be put in at any time.

Roentgen Ray Burns.—In repairing roentgen ray burns wide excision and immediate grafting with thick split-skin grafts will give the most consistently

good results. If ulceration is present, or if there is bone or tendon exposed in the fingers, amputations may have to be performed, or a pocket-flap from the thigh or abdomen resorted to, but, with the promise of success by early

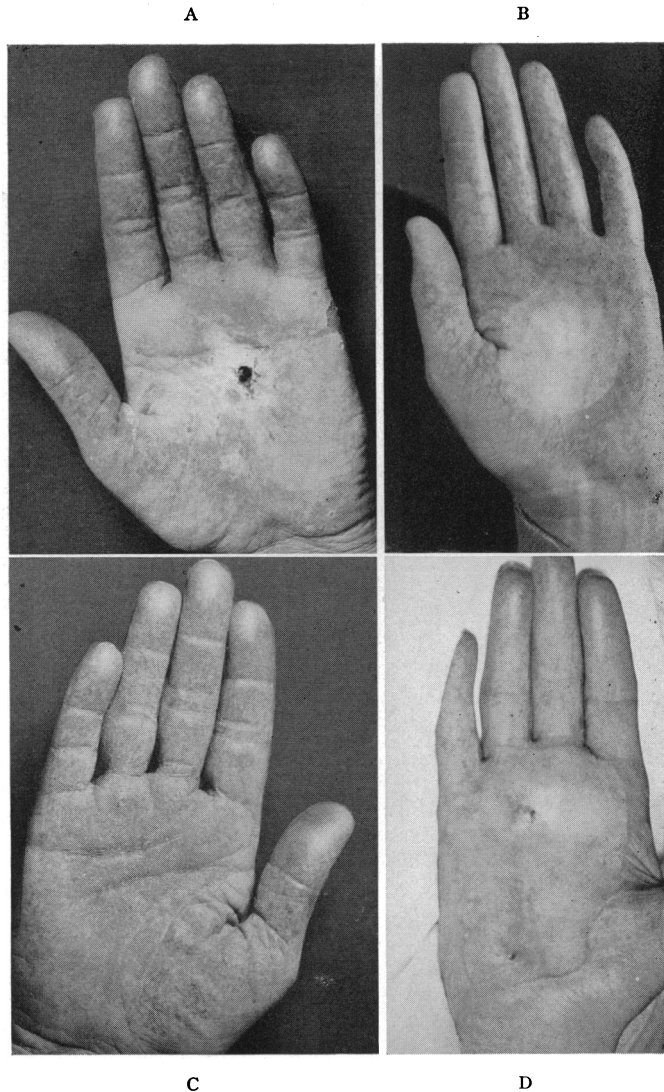


FIG. 10.—(A) and (C) Roentgen ray burns of entire palmar surfaces of both hands, with ulceration in the left that requires immediate removal. (B) and (D) Split-graft restorations in left hand after three years, in the right after three months. Normal function and sensation present in the left and anticipated in the right.

widespread free-skin grafting, most patients should fall short of this degree of neglect.

There have been so many failures with immediate free-grafting of roentgen ray burns that many surgeons prefer to excise the lesion first and then later graft a fresh granulating bed. There is, also, serious argument against im-

mediate grafting or application of flaps in any patient with a history of repeated infection or evidence of deep inflammation about the area. These areas should probably all be excised first, and repaired later, to avoid, as far as possible, serious crippling infection.

The patient in Fig. 10 *A* and *C* had widespread burns of both palms with ulceration in the left one. The first problem was to get rid of the changing area and repair it as well as possible. These areas are prepared with repeated soap and water cleansings and wet dressings for four days, and then widely and deeply excised without contamination of the deep area with the surface ulceration. The defect is covered with a single thick split-graft and a continuous wet pressure dressing maintained for four days. The area is then carefully nursed along until healed, and, in this patient, the final result is shown to be satisfactory with normal function persisting after three years (Fig. 10 *B*). The rest of the palmar skin will eventually have to be replaced, but at this time the entire palm of the opposite hand is removed and replaced with a single thick, split-graft in one operation (Fig. 10 *C* and *D*).

This procedure greatly simplifies matters for the patient, if successful, and eliminates the use of flaps in many instances. If the graft is lost, the patient is not far behind the two-stage procedure of later grafting, except that he has one more donor area to heal. In using split-grafts correctly this should practically never happen. The full-thickness of an immediate free full-thickness graft on a roentgen ray burn area is so questionable that they are seldom employed.

Complete Amputation of Finger Tips.—This subject is mentioned because of much conjecture regarding it, many misstatements of success and because one authentic success can be reported. The finger shown in Fig. 11 is the result of suture of the entire tip after it had been completely severed by a circular bread knife and had dropped down in the box. The loss was oblique from below the nail, and the amputated piece contained the entire nail and pad and possibly a very small piece of bone. The tip was put back on and about one hour later, the wound was inspected and the tip was again replaced, and this time accurately sutured. There was a complete take of the graft, with a rather slow course because of the heavy keratinized layer coming away, and, of course, the entire nail. There was, however, complete regeneration of the nail and its eponychium so that it appears normal. Dr. S. L. Koch saw the patient and suggested the possibility of grafting nails in this manner, but so far a patient with a good enough toe-nail to be placed on a finger has not been encountered. (Free-grafts of nails and part of their beds have not

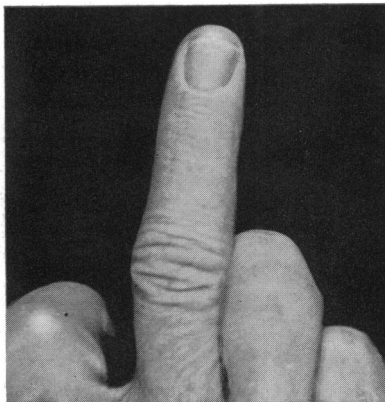


FIG. 11.—Complete restoration of tip of finger, including entire nail, eponychium and pad, by immediate resuture after it had been completely amputated and detached by a bread-cutting machine.

been successful enough to report here.) It is thought that where there has been a clean amputation of a finger tip, immediate suture should be performed if possible. Crushing losses are not so likely to give good results, and immediate free-grafts can be utilized or a pad supplied later by a simple flap from the palm.

Web Fingers.—This lesion is mentioned because congenital cases never seem to have enough skin in the webs to give satisfactory covering of the sides of the fingers if normal flaps are put between the fingers. This interdigital flap is turned as a square U from the dorsal surface—as dorsal skin normally exists between the fingers—and is placed into an inverted T incision on the palmar surface. Then any flaps available are used on the sides, but there will practically always be defects that cannot be closed without

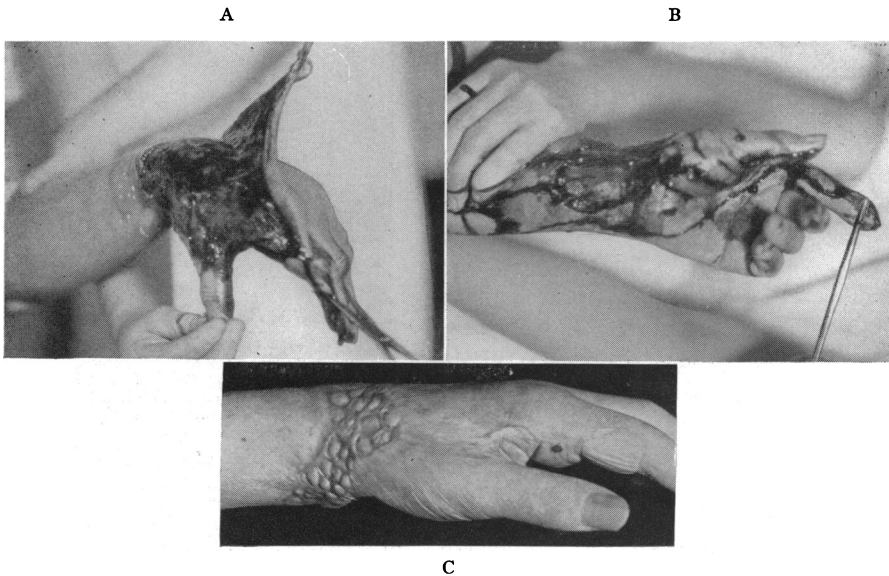


FIG. 12.—(A) and (B) Very wide flap torn by electric wringer with base distal. (C) Result of flap suture and loss, and subsequent closure of wound with small, deep grafts.

tension, and one premise of working with all defects in the hand is that they should be closed. Thick split-grafts are, therefore, sewed in place between the fingers and light sponge pressure dressings applied.

Two sides of one finger are never operated upon at the same time, so that in this patient two operations were necessary. This is the advice of Dr. Allen Kanavel, and the author has seen the loss of the ends of three fingers where this advice had not been followed.

Wringer and Other Laundry Machine Injuries.—Fairly frequent injuries are seen from catching the hand in electric wringers, and there is usually a large flap torn away with its base distal; there is seldom any tendon or bone damage, and, in a child, the tear may not occur until the arm has come between the rollers.

Many of these cases can be repaired by immediate resuture, and, if it is

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possible to determine that viability of part of the flap is lost, this can be trimmed away and an immediate free-graft applied. The patient shown in

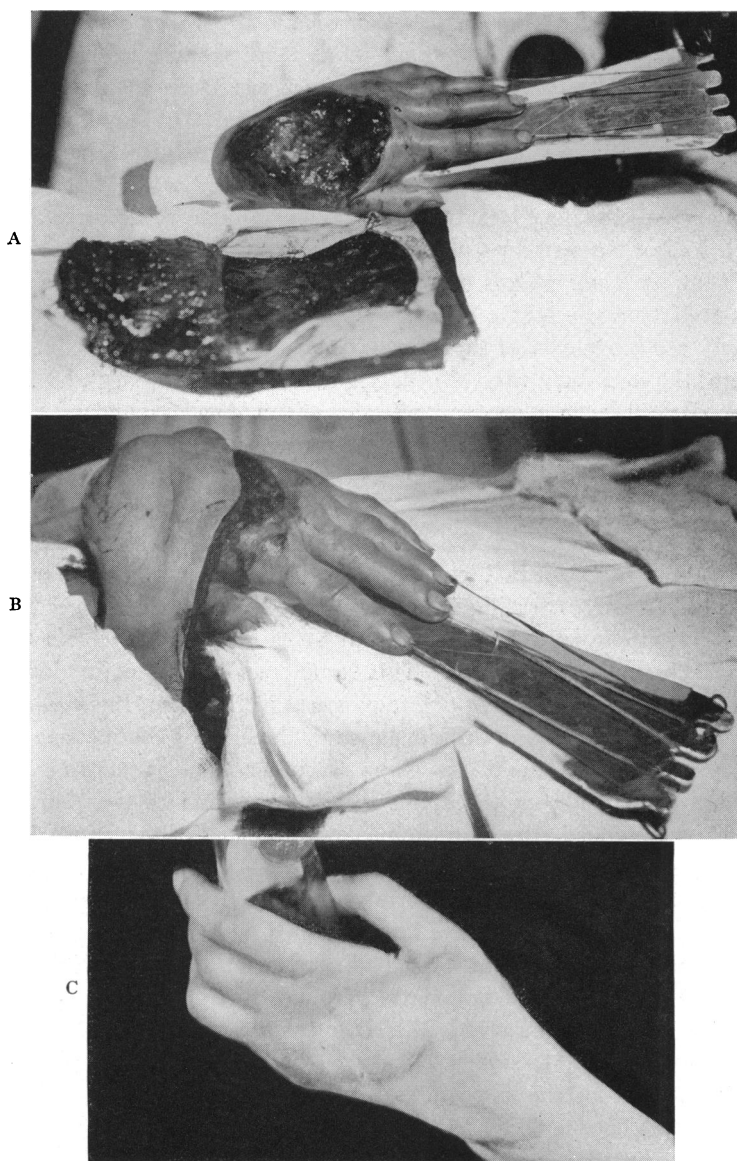


FIG. 13.—(A) and (B) Shotgun wound of hand with repair by a direct pedicle flap from the abdomen. Hand splinted to give traction for the fingers, and thumb rotated. Same splint used after hand is detached to obtain joint motion and maintain traction. A small wound of entry on the palmar surface was left to close itself. (C) Result is a hand that is far superior to any prosthesis that might be devised.

Fig. 12 had a very large flap torn loose, and, because of poor physical condition, a chance was taken in replacing all of it. There was loss around the

wrist, and healing has been hurried with small deep grafts applied without anesthesia.

Other laundry injuries are shown in Figs. 1 and 2. Some have tendon, joint or bone damage, so that pedicle-flap repairs become necessary.

Pedicle-Flap Repairs of the Hand.—There are definite indications for the use of thick pedicle flaps in hand repairs, such as: Deep roentgen ray burns of the dorsum; gunshot wounds; any deep wound that exposes too much tendon, bone or joint; or any late repair that will subsequently need work on tendon or bone and which could not be accomplished with just a free-graft restoration of the surface. A broad or double pedicle can nearly always be arranged so that the flap does not have to be delayed.

Probably as many pitfalls occur in the use of flaps as in free-grafts, and patients are frequently seen with inadequate flaps, bunched up in a pad on the hand, only replacing part of the deformity.

One of the necessary uses of a flap is illustrated in Fig. 13 *A*. The hand was placed right over a shotgun muzzle, and a small wound of entry was present on the palm, but with the huge excavation shown on the dorsum. Amputation had been considered, but it was suggested that at least an attempt might be made to save the hand. Accordingly, after eight days of cleaning the area, a direct flap from the right lower quadrant was sewed in place. Important points, shown in Fig. 13 *A* and *B*, are that the hand is on a splint from the start—even carrying it across the abdomen. The fingers are held extended by simple rubber traction from holes in the finger nails to simple notches on the end of the splint. This same traction was maintained during the entire period of attachment of four weeks; otherwise, there would have been retraction of the fingers the distance of the loss of the metacarpals, and also marked bunching up of the flap. Another important point is that a cut-out has been made on the splint to allow rotation of the thumb. This splint can be employed after operation to gain freedom of the joints, by simply bending the splint with the hand on it. The result (Fig. 13 *C*) is a hand that is useful in all housework, far superior to any artificial one, and superior to any possible result that could have been obtained with a free skin graft.

The patient shown in Fig. 14 *A* had a contraction of the hand and wrist from an infection that had bound the tendons so tightly that there was no movement. At operation a wide dissection of the scar was effected, and the wrist let down, with so much exposure of deep structures that a direct abdominal flap from the opposite lower quadrant was put in place. The abdominal wall itself is used as a splint in this instance with the wrist and hand flexed around it as comfortably as possible (Fig. 14 *D*). The final result with the wrist flexed is shown in Fig. 14 *B* and *C*, but without much flexion in the metacarpophalangeal joints. The remaining wide, raw area over the abdomen is covered with split-grafts, as this seems better than drawing the area together or letting it heal itself.

Occupational and Physical Therapy.—Following surface repairs in which there has been no deep involvement, if a good result can be obtained and the

REPAIR OF DEFECTS OF HAND

patient is fairly interested in his recovery, very little else need be done about his rehabilitation. Children usually work out their own problems but, if much joint stiffness has developed, considerable difficulty may be experienced in getting it out of the metacarpophalangeal joints, and especially in women who are not likely to need this joint completely flexed. Simple work in the home with the early use of rubber sponge exercise in closing the hand, and

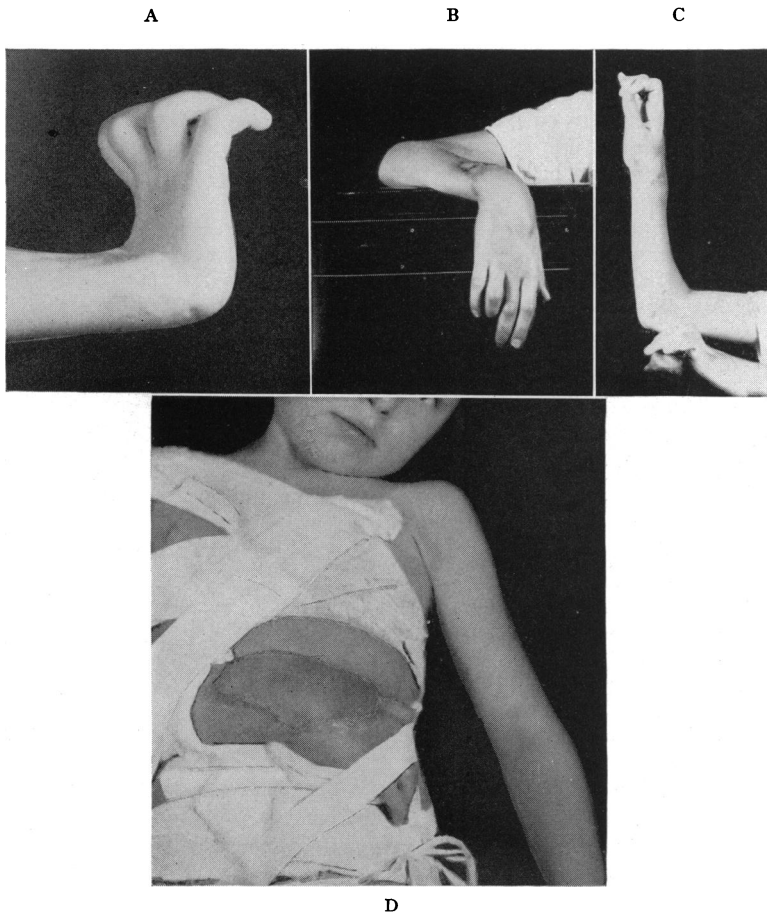


FIG. 14.—(A) Extension deformity of fingers and wrist following a wide skin loss and tendon damage from infection. (B) and (C) Voluntary flexion of wrist, but not much flexion of metacarpophalangeal joints obtained. However, the hand, in general, almost normal in function. (D) Hand splinted across abdomen, with flexion maintained and direct abdominal flap growing in place.

such grosser movements as sweeping, shoveling, *etc.*, may quickly loosen the joints. Manipulation to swing thumbs around into place may be done frequently, but forced manipulation of these joints rarely produces anything but more stiffness. Elastic traction and rotation of the thumb as illustrated in Fig. 13, and as advocated by Kanavel, Koch and Mason for rehabilitation in deeper repairs, will produce the quickest freeing of joint fixation. The finer movements of the interossei and lumbricals can be greatly stimulated by occu-

pational therapy, and many excellent results may be obtained. Secondary operative procedures on the metacarpophalangeal joints may occasionally be of benefit and very badly dislocated phalangeal joints may be resected or an attempt at arthroplasty instituted, but the indications for this last procedure are very infrequent.

DISCUSSION.—DR. J. M. T. FINNEY, SR. (Baltimore, Md.).—In substantiation of what Doctor Brown has said about severed members and their replacement, I should like to report a personal experience. Many years ago a young man came to the Johns Hopkins Hospital Dispensary with the ends of two fingers—the ring and middle fingers—cut squarely off by a chopping machine. He was a tin cutter by trade. The middle finger had been severed just below the last joint, leaving a small disk of the terminal phalanx; the ring finger, just at the base of the nail. He said the accident had occurred over five hours previously.

The cut surfaces looked clean; the bleeding had stopped. I asked what had become of the severed ends of the fingers. He put his hand in his pocket and pulled out a piece of newspaper, from which he produced the missing finger ends. They looked clean, so I soaked them and the stumps of the fingers for at least an hour in warm salt solution. I then took a sharp knife and carefully scraped both cut surfaces of each finger, and carefully replaced them. One stitch of fine silk was taken in each of the four cardinal points. I then held the fragments in close and accurate apposition by narrow strips of crepe tissue over the end, extending up the finger on both sides, held in place by collodion, which splinted the fragments perfectly. The fingers were then put up together on a splint. Perfect healing per primam was obtained, without any infection, in each finger. I followed the patient for some years afterwards, at the end of which time use and sensation were perfect.

I want to congratulate Doctor Brown on his excellent paper and his splendid results. The history of the development of plastic surgery is a most interesting one. The results to-day, compared with those of 50 years ago, are extraordinarily satisfactory.

DR. ELLIS FISCHER (St. Louis, Mo.) did not think that one should lose sight of the fact that many years of patient trial and error were involved in the evolution of the meticulous technic recited by Doctor Brown. He also felt that very few would have the patience to undertake the essential details, not only of the operation but also of the dressings, that were necessary. However, there are some simple things a general surgeon can do to repair defects in the hands which he himself creates. In carcinoma of the back of the hand, which does not involve the tendon sheaths, and which occurs usually in elderly people, it is not necessary to employ irradiation by either roentgen ray or radium. It is easy to excise a lesion the size of a silver dollar, or even larger, under infiltration anesthesia, and immediately repair the defect by a skin graft. Healing occurs in about ten days' time.

A similar but more difficult procedure can be employed to repair the defect caused by excision of a carcinoma arising in old roentgen ray burns. In these cases not only the tumor but all the neighboring scar tissue should be excised, and the resultant soft tissue defect should be repaired immediately by the method so ably illustrated by Doctor Brown; namely, by suturing a split- or full-thickness graft into the defect. A careful pressure dressing is essential to the success of this procedure, which gives eminently satisfactory results with a minimum of time for after-care.

DR. JOHN STAIGE DAVIS (Baltimore, Md.) said he would like to congratulate Doctor Brown on the splendid work he had shown today. He had been interested in whole-thickness skin grafting for a long time; in fact, the first paper he ever wrote was on the relief of scar contractures by the use of whole-thickness grafts. These grafts should be employed more than they are; but unless one is familiar with the technic and has had experience in handling these grafts, he will not get as good results as have been shown in this very unusual presentation of Doctor Brown's.